Product Carbon Footprint

Product Carbon Footprint:
Life Cycle Assessment Report for
Russian Mining Chemical Company LLC
t/a Brucite+

Brucite+

A study of MagTreat-P and MagTreat-S

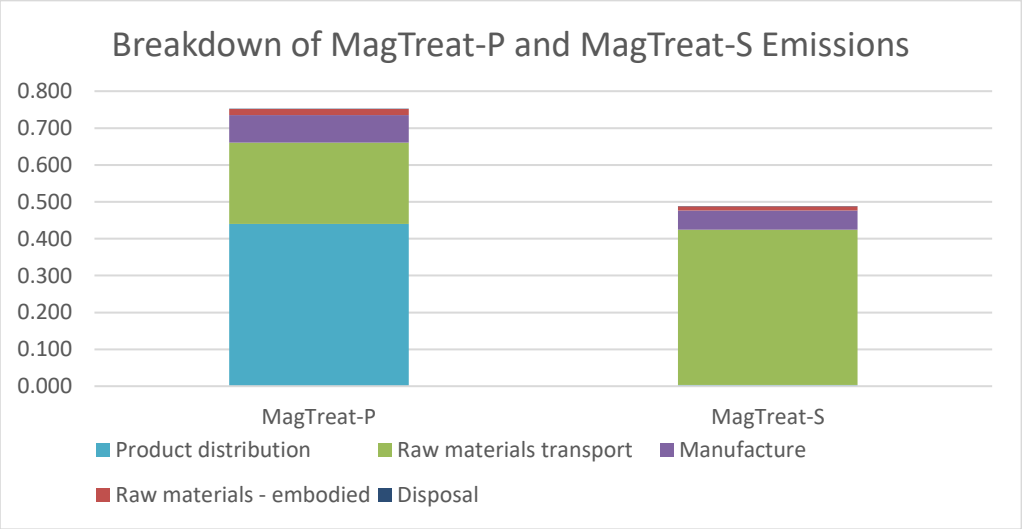
MagTreat

Executive Summary

This executive summary provides an overview analysis of the greenhouse gas emissions associated with 1kg of Russian Mining Chemical Company LLC (trading as Brucite+)'s MagTreat-P and MagTreat-S. This assessment focuses on the embodied raw material emissions, the transport of these materials, the manufacture, processing and limited distribution of each product. The total cradle to gate product footprint lifecycle emissions for a kg of MagTreat-P and MagTreat-S are 752 gCO_2e and 488 gCO_2e respectively.

MagTreat is a magnesium hydroxide ($Mg(OH)_2$) product that Brucite+ creates from raw brucite (mineral form of $Mg(OH)_2$) that the company mines in the Jewish Autonomous Region of Russia. The brucite is transported to Vyazma where it is first made into a powder (MagTreat-P). The powder is then transported to Wide Scope where some is sold as is, whilst the rest is made into the suspension (MagTreat-S) by adding water in a 65:35 mix of MagTreat-P to water.

The following graphs show the percentage breakdown of emissions for the MagTreat-P and MagTreat-S. Transport accounts for the majority of the total emissions for both products, 87.8% and 87.0% for MagTreat-P and MagTreat-S respectively. Product distribution is the largest proportion of MagTreat-P's emissions, due to the journey between Vyazma and Wide Scope in Belgium, by truck. For MagTreat-S, this section of the transport is included in the transport of materials, as there is another stage of manufacturing before distribution. It should be noted that product distribution accounts for moving the product to its distribution centre and not to the end-user.



Process	Emissions (gCO_2e)	
	MagTreat-P	MagTreat-S
Raw materials - embodied	17	14
Raw materials transport	220	421
Manufacture	75	52
Product distribution	440	4
Disposal of waste/offcuts	<1	<1
Total	**752**	**488**

To help differentiate Brucite+'s products from competitors, bring additional PR and CSR opportunities and to compensate for Brucite+'s emissions whilst ensuring that the projects supported are providing the required carbon reduction benefits, we recommend that Brucite+ strives to achieve our **Carbon Neutral** Standard by offsetting their carbon emissions through certified carbon offset projects.

As the emissions per kg are 752 gCO_2e and 488 gCO_2e for MagTreat-P and MagTreat-S respectively, this means offsetting 1 tCO_2e for every 1,330 kg of MagTreat-P or 2,049 kg of MagTreat-S sold, would make the products carbon neutral.

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Quality Control

Report issue number:	1.0
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Calculations reviewed by:	Grace Parker
Report produced by:	Joel Fernandez
Report reviewed by:	Grace Parker
Director:	John Buckley

1. Introduction

1.1 Scope of this Assessment

The aim of this assessment is to demonstrate the product carbon footprint of Brucite+'s MagTreat-P and MagTreat-S products. This is the first assessment Brucite+ has completed and will be used to demonstrate to their clients the environmental credentials of their products and to help give their product an edge in an increasingly competitive marketplace.

Carbon emissions for the product assessed in this report include those derived from the extraction and processing of virgin raw materials, the transport of these components to the factory in Dong Guan, the production of packaging and the product assembly, product distribution, emissions from use and disposal of the product.

1.2 What is a Product Life Cycle Assessment (LCA)?

Product LCA is the assessment of the environmental impacts of a product or service during its life cycle. It incorporates the analysis of raw materials, manufacture, transport, usage and disposal. LCA can evaluate several environmental impacts (air pollution, ozone layer depletion, climate change, etc.) or focus on a single impact (e.g. climate change). When only climate change is considered it is called product carbon footprint or carbon LCA.

The product carbon footprint detailed in this report is a *Cradle-to-Gate* carbon LCA.

1.3 How is the product carbon footprint calculated?

The product carbon footprint is derived from a combination of activity data provided by Brucite+ and from publicly available sources (primary data) and emission factors extracted from internationally recognised metrics. Greenhouse gas (GHG) activity data is then multiplied by GHG emission factors to produce carbon metrics.

To guarantee transparency and reproducibility, the emission factors used in this report are shown in Annex 1 detailing the exact name of the emission factor as it appears on its respective database. Material emissions factors are sourced either from EcoInvent's database (v3.7.1) or the UK Government (BEIS, 2020). All EcoInvent factors account for all processes during the production of raw materials and all processes (including transport). As Brucite+ extracts brucite material from the ground, the energy associated with this extraction was used to work out the embodied emissions of this material.

Electricity generation emissions factors for The Russian Federation are based on 2019 data, sourced from the Climate Transparency 2020 Report; and transmission and distribution were based on Defra 2017 data. Belgian electricity generation emissions factors were from the Association of Issuing Bodies data from 2020, transmission and distribution factors were also taken from Defra 2017.

1.4 Abbreviations

AIB	Association of Issuing Bodies
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
BEIS	Department for Business, Energy and Industrial Strategy
Defra	Department of Environment, Food and Rural Affairs
g	Grammes
GHG	Greenhouse Gases
kg	Kilogrammes
km	Kilometres
kWh	Kilowatt Hours
LCA	Life Cycle Assessment
$Mg(OH)_2$	Magnesium hydroxide
PET	Polyethylene Terephthalate
pH	Potential of hydrogen
TPE	Thermoplastic Elastomer

2. Product overview

2.1 MagTreat

Brucite+ is a Russian based mining company that extracts material from the ground and processes it. MagTreat is a magnesium hydroxide ($Mg(OH)_2$) based product that can be used in wastewater treatment, marine exhaust gas cleaning in scrubbers and flue gas desulfurisation applications. The product is used as a buffer for pH 9.5. This report looks at the emissions of the powder (MagTreat-P) and the suspension (MagTreat-S) products.

Within this assessment, the emissions associated with the raw materials, transport, production and distribution up to the distribution centre of the MagTreat and packaging are examined. The main raw material in both MagTreat products is brucite, which is mined in the Jewish Autonomous Region of Russia. This brucite is transported via rail freight, 8600km, to Vyazma-Brucite LLC factory, also in Russia. The material is transported in 2.7kg polypropylene big bags. As the mass of these bags used per kg of material is 2.7g, the transport of this material from the source has been excluded in this assessment, as it will contribute to less than 5% of emissions.

At the Vyazma factory, the brucite is ground and milled to create MagTreat-P. The MagTreat-P is then transported by truck, 2,332km, to Wide-Scope in Belgium. In Belgium, some of the MagTreat-P is mixed with water at a ratio of 65:35 (MagTreat-P:water) to create MagTreat-S, the rest is kept as MagTreat-P. The MagTreat-P is distributed by truck, whilst for the MagTreat-S, an estimated 80% is transported by barge up the river Scheltz with the remaining 20% by truck. The distribution past this point has not been accounted for, as this assessment is cradle-to-gate. The products are packaged differently depending on the quantity purchased by the customer, most buying in bulk quantities, making this source of emissions incalculable and minimal. As such, the packaging has not been included in this assessment.

Table 1: Overview of all raw material used to produce MagTreat-S and MagTreat-P

Component	Material	Material mass in 1kg of product (g)		Offcuts/Waste in 1kg of product (g)	
		MagTreat-P	MagTreat-S	MagTreat-P	MagTreat-S
	Product				
$Mg(OH)_2$	Brucite	1,000	650	-	-
Water	Water	-	350	-	3.5
Subtotal		**1,000**	**1,000**	**-**	**3.5**
	Packaging				
Big Bag	Polypropylene	-	-	2.7	2.7
Subtotal		**-**	**-**	**2.7**	**2.7**
Total Mass (kg)		**1,000**	**1,000**	**2.7**	**6.2**

3. Accuracy of the carbon footprint LCA calculation

The accuracy of the overall carbon footprint calculations for Brucite+'s MagTreat products (Table 2) is very good as the majority of the data used in the calculation is primary data submitted by Brucite+. This includes the amounts of raw material in the product and source locations, energy use in production, product distribution and disposal.

Table 2: Source data and calculation accuracy for MagTreat products

Dataset	Source of data and comments	Accuracy
Raw materials Embodied emissions	Electricity given in kWh and fuel consumed to extract 1kg of Brucite. Polypropylene bag mass provided. Water amount given as a ratio for MagTreat-P, 1% of water was assumed to be lost as an offcut.	Very Good
Raw materials Transport	Factory locations given, along with the measured distance between them and limited details about the vehicles used. For MagTreat-S, the transport of MagTreat-P to Wide Scope by truck was included here, as MagTreat-P was a constituent material in the product.	Good
Manufacturing	Electricity kWh and fuel consumption in litres was provided for the grinding and milling processes at the Vyazma-Brucite LLC site. Also, the energy required in the conversion of MagTreat-P to MagTreat-S at Wide Scope.	Excellent
Product distribution	Distribution starts from Vyazma-Brucite LLC for MagTreat-P and from Wide Scope for MagTreat-S. Limited distribution information could be provided as customers have different delivery requirements, due in part to the different amounts of product purchased and different distances to deliver. All Brucite+'s logistics are accounted for by the transport by barge and truck to the distribution centre in Antwerp. The "gate" finishing point is after this point, as the products are then distributed to customers.	Good
Disposal Waste/Offcuts	An additional 1% water was estimated to be wasted; this could be due to evaporation or spillage. The Brucite was assumed to have no waste, as this is extracted from the ground and makes up 100% of MagTreat-P.	Good

4. Carbon Footprint LCA Results

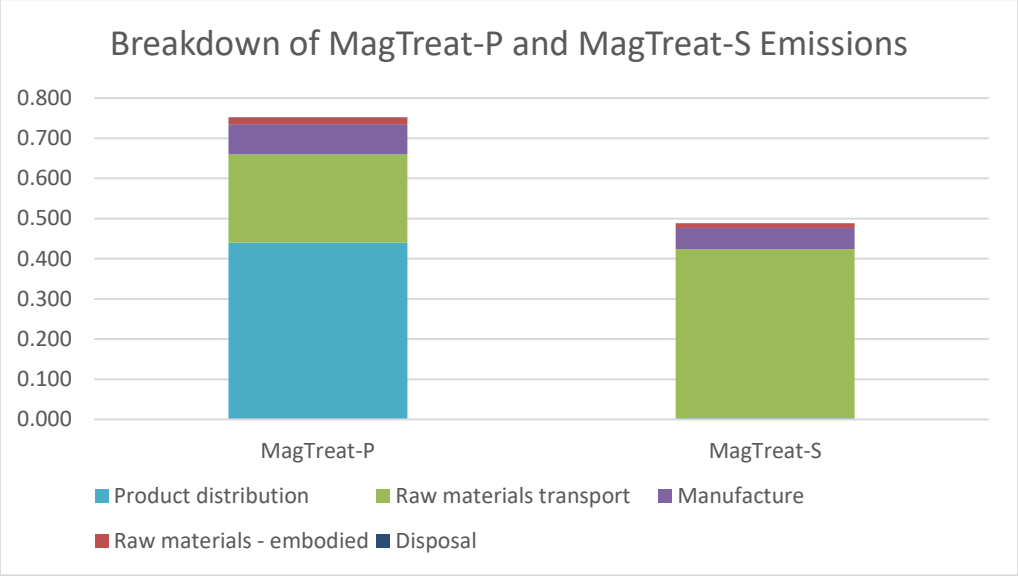
4.1 Summary of results

This report provides an analysis of the greenhouse gas (GHG) emissions associated with 1kg of MagTreat-P and 1kg of MagTreat-S. The total ***cradle-to-gate*** product life cycle carbon emissions for the product is shown in the following table and chart; split by lifecycle stage.

Table 3: GHG emissions per kg of product

Process	Emissions (gCO_2e)	
	MagTreat-P	MagTreat-S
Raw materials - embodied	17	11
Raw materials transport	220	421
Manufacture	75	52
Product distribution	440	4
Disposal	<1	<1
Total	**752**	**488**

Figure 1: Emissions breakdown of Brucite+'s MagTreat-P and MagTreat-S



As is evident from Table 3 and the figures above, transport related emissions represent the largest part of each footprint, 87.8% of MagTreat-P's emissions coming from these sources and 87.0% of MagTreat-S's emissions. Raw materials transport is defined by all transport operations before the product is fully manufactured, distribution is after this point. This definition is the reason why product distribution is larger for MagTreat-P, and raw materials transport is larger for MagTreat-S.

Manufacture is the highest emissions source after transport with 10.0% and 10.7% of emissions for MagTreat-P and MagTreat-S respectively. The overall emissions for MagTreat-S are 35.1% lower than MagTreat-P, as the added 35% by mass of water has lower embodied and transport emissions than the Brucite.

4.2 Embodied emissions from raw materials

Embodied emissions for Brucite were calculated based on Brucite+'s extraction of the mineral from the ground. Each kg of Brucite requires 0.003625 kWh electricity and 0.002867 litres of diesel for the machinery that is used to extract the material. The electricity and diesel cause 1 gCO_2e and 8 gCO_2e of emissions respectively, making the total emissions for the extraction of each kg of brucite to be 9 gCO_2e. Therefore, the embodied of emissions of brucite are 9 gCO_2e per kg of MagTreat-P and 6 gCO_2e per kg of MagTreat-S.

The polypropylene "big bags" used to transport the brucite from the mine to the Vyazma-Brucite LLC site weigh 2.7 kg and can carry 1 tonne of material. As such, 2.7 g of polypropylene are required per kg of brucite. This means that MagTreat-S has lower emissions from this source than MagTreat-P, because it contains a lower proportion of $Mg(OH)_2$, due to being mixed with water.

The water used in MagTreat-S comes from the Belgian water supply. Factors were not available for this particular network, so emission factors per million litres of water used, supplied by Defra were used here (please note that 1 litre of water is equal to 1 kg, by definition). By mass, a ratio of 65:35 of MagTreat-P:Water is used to create MagTreat-S. It was estimated that 1% water used was lost as waste, and was assumed to be treated in the Belgian sewage system. The emissions caused by the supply of water was for this application is very low, at 122 $mgCO_2e$ per kg MagTreat-S.

Table 4 details the breakdown of the embodied emissions of materials used in the manufacture of MagTreat products.

Table 4: Embodied CO_2e emissions of raw materials for MagTreat products

Element	Material	Raw Material Emissions (gCO_2e per kg)	
		MagTreat-P	MagTreat-S
Product	Brucite	9	6
	Water	-	<1
Packaging	Polypropylene	8	5
Total		**17**	**11**

4.3 Emissions from transport of raw materials

The emissions associated with transport reflect the mass of each component, the mode of transport and the distance travelled.

The brucite, in polypropylene "big bags", is taken by rail freight from the mine in the Jewish Autonomous Region of Russia to the factory at Vyazma-Brucite LLC, also in Russia, where it is ground and milled into MagTreat-P. This journey is 8,600 km. The emissions of this journey per kg of Brucite is 221 gCO_2e, remembering that emissions from this source for MagTreat-S will be lower than MagTreat-P, as it requires less brucite.

At this point, MagTreat-P is in its final form, so all freight after this is classified as product distribution. However, the MagTreat-S is diluted at the Wide Scope site in Belgium. The MagTreat-P is transported to Wide Scope in trucks, a distance of 2,332 km from Vyazma-Brucite LLC. This results in MagTreat-S having higher raw material transport emissions than MagTreat-P.

Table 5: Transport of raw material emissions for MagTreat products

Product Element	Freight Type	Freight Distance (km)	Raw material transport emissions (gCO_2e per kg)	
			MagTreat-P	MagTreat-S
Brucite mineral	Rail	8,600	220	143
Polypropylene bag	Rail	8,600	1	<1
MagTreat-P	Truck	2,332	-	277
Total		**-**	**221**	**421**

4.4 Emissions from Manufacturing

Emissions from the manufacture of the MagTreat products have been calculated using energy consumption data supplied by Brucite+ (Table 6). Energy consumption figures were provided in consumption per kg of product, based on annual consumption divided between the products that are produced on site.

At Vyazma-Brucite LLC, the brucite mineral is ground and milled into MagTreat-P. Per kg of MagTreat-P created, 0.1603 kWh of electricity are used, and 6.51 litres of natural gas and 0.527 ml diesel are combusted.

Some of the MagTreat-P is converted to MagTreat-S at the Wide Scope site in Belgium. To create 1 kg MagTreat-S, water is added to MagTreat-P. In doing this, 0.01551 kWh of electricity is used and 0.382 ml of gas oil are combusted. This causes 4 gCO_2e per kg of MagTreat-S.

Table 6: Production emissions for MagTreat products

Factory Location	Manufacturing emissions (gCO_2e per kg)	
	MagTreat-P	MagTreat-S
Vyazma-Brucite LLC, Russia	75	49
Wide Scope, Belgium	-	4
Total	**75**	**52**

4.5 Emissions from Transport and Distribution of Products

Distribution starts after the completion of a product. For MagTreat-P, this is after the grinding and milling operations at the Vyazma-Brucite LLC facility in Russia. For MagTreat-S, this is after water is added to MagTreat-P to make the final product at Wide Scope in Belgium.

The journey between Vyazma-Brucite and Wide Scope is 2,332 km, the MagTreat-P is taken this distance by truck, causing 427 gCO_2e emissions per kg of MagTreat-P transported. The MagTreat-P that is left in this form is then transported by truck to Antwerp, 70 km, causing another 13 gCO_2e per kg of MagTreat-P.

After MagTreat-S is created at Wide Scope, the product is transported by two means. The first transport method, by which an estimated 80% of the total product output is taken is by barge, up the river Scheltz to Antwerp. This is a 105 km trip that causes 1 gCO_2e per kg of MagTreat-S produced. The other 20% of MagTreat-S is transported by truck to Antwerp, causing emissions of 3 gCO_2e per kg of MagTreat-S produced.

The emissions per kg of MagTreat-S are much lower in this section than MagTreat-P. This is a result of the transport to Wide Scope being part of the raw material transport for MagTreat-S. As shipping has a lower emissions per tonne.km than truck, this also causes lower emissions in MagTreat-S.

Table 7: Product distribution emissions

Origin	Destination	Transport method	GHG emissions (gCO_2e per kg)	
			MagTreat-P	MagTreat-S
Vyazma-Brucite LLC, Russia	Wide Scope, Belgium	Truck	427	-
Wide Scope, Belgium	Antwerp	Sea	-	3
Wide Scope, Belgium	Antwerp	Truck	13	1
Total			**440**	**4**

A more detailed breakdown of these emissions is available in Annex 2.

4.6 Emissions from Disposal

Disposal of wastes and offcuts was modelled for materials that were not in the final product. As brucite is mined from the ground, this had no offcuts. The polypropylene "big bags" are treated as offcuts, as these do not stay in the final product. These bags are recycled and reused, for the purpose of this assessment, it is assumed that all are recycled. An extra 1% of water used was considered waste that would require treatment. The amounts of CO_2e these disposals cause is minimal, shown in Table 8.

Table 8: Disposal emissions for MagTreat

Disposal Element	Disposal Method	Disposal emissions ($mgCO_2e$ per kg)	
		MagTreat-P	MagTreat-S
Water	Treatment	-	2
Polypropylene (Packaging)	Recycled	58	37
Total		**58**	**39**

5. Carbon Footprint Standard

5.1 Brand endorsement

Brucite+ in conjunction with Carbon Footprint Ltd, has assessed the cradle-to-gate carbon emissions associated with 1kg of MagTreat-P and 1kg of MagTreat-S. By achieving this, Brucite+ has qualified to use the Carbon Footprint Standard branding. This can be used on all marketing materials, including web site and customer tender documents, to demonstrate your carbon management achievements.

The Carbon Footprint Standard is in recognition of your organisations commitment to manging your products' carbon emissions. The text to the right-hand side of the logo demonstrates what level you have achieved in line with international best practice.

6. References

1. Association of Issuing Bodies (AIB), 2020, 2019 European Residual Mix, available at https://www.aib-net.org/facts/european-residual-mix
2. Climate Transparency 2020 report, *Russian Federation, Country Profile 2020*, available at: https://www.climate-transparency.org/wp-content/uploads/2020/11/Russia-CT-2020-WEB.pdf
3. EcoInvent database v3.7.1 2020, available at http://www.Ecoinvent.org/
4. Guidelines to Defra's Greenhouse Gas (GHG) Conversion Factors for Company Reporting – annexes (June 2013)
5. UK Government GHG Conversion Factors for Company Reporting (August 2020)
6. UK Government GHG Conversion Factors for Company Reporting (August 2017)

Annex 1: Emission Factors

The following table shows the emission factors used for the calculations contained in this report.

Table 9: Emissions factors used in this assessment

Element	Emissions factor	Comments	Unit	Database
Raw Materials (embodied)				
Brucite	0.009073	Calculated using details about electricity from Russian Federation grid used & diesel fuel burned	$kgCO_2e$ per kg material	Climate Transparency 2020 Report and UK Government 2020 and 2017
Water Supply	0.000344	Defra 2020 Water supply emissions factor		UK Government 2020
Polypropylene (packaging)	**See Footnote**	market for textile, non-woven polypropylene (GLO)		EcoInvent 3.7.1
Transport				
Lorry - Rigid >17t	0.18306		$kgCO_2e$ per tonne.km	UK Government 2020
Rail Freight	0.02556		$kgCO_2e$ per tonne.km	UK Government 2020
Ship – General Cargo	0.013232	Average Load	$kgCO_2e$ per tonne.km	UK Government 2020
Manufacture				
Russian Federation (Electricity Generation & T&D)	0.37712	Climate Transparency Report 2020 based on 2019 data.	$kgCO_2e$ per kWh	Climate Transparency 2020 & Defra 2017
Belgium (Electricity Generation & T&D)	0.16141	AIB 2020 and Defra 2017	$kgCO_2e$ per kWh	AIB 2020 and Defra 2017
Diesel	2.68787		$kgCO_2e$ per litre	UK Government 2020
Gas oil	2.75776		$kgCO_2e$ per litre	UK Government 2020
Natural gas	2.02266		$kgCO_2e$ per m^3	UK Government 2020
Disposal				
Polypropylene (packaging)	21.3167		$kgCO_2e$ per tonne material	UK Government 2020
Water Treatment	0.708			

Please note – In accordance with IEA and EcoInvent's End User Licence Agreement (EULA) emissions factors cannot be presented in the report. A full emissions factor reference has been provided which will allow users with an active EcoInvent account to search for the emissions factor. Please see http://www.Ecoinvent.org/ for further details and to search for factors.

Annex 2: Transport Data

Table 10 shows the details of the transport data provided for each product component for the MagTreat products. All are transported by truck (average HGV).

Table 10: Breakdown of transport types and journey data provided for the transport of raw materials to factory

Component	Location of material source	Leg 1	Type of Transport	Total Distance (km)	Emissions (gCO_2e per kg)	
					MagTreat-P	MagTreat-S
Brucite	Jewish Autonomous Region, Russia	Vyazma-Brucite LLC, Russia	Rail	8,600	221.8	142.9
Polypropylene (Packaging)	Jewish Autonomous Region, Russia	Vyazma-Brucite LLC, Russia	Rail	8,600	0.6	0.4
MagTreat-P	Vyazma-Brucite LLC, Russia	Wide Scope, Belgium	Truck	2,332	-	277.5
				Total	**222.4**	**420.8**

Table 11 shows the details of the shipping and distribution data provided for the MagTreat products.

Table 11: Breakdown of transport types and journey data provided for the shipping and distribution of the product

Product	Factory location	% of product units	Origin	Leg 1	Leg 2	Type of Transport	Total Distance (km)	Transport emissions (gCO_2e per kg of product)
MagTreat-P	Vyazma-Brucite LLC, Russia	100%	Vyazma-Brucite LLC, Russia	Wide Scope, Belgium	Antwerp	Truck	2,402	439.7
MagTreat-S	Wide Scope, Belgium	80%	Wide Scope, Belgium	Antwerp	-	Ship	105	1.1
		20%				Truck	70	2.6